

REMARKS

This amendment is responsive to the August 10, 2009, Office Action. Applicants respectfully request reconsideration of the application, withdrawal of all rejections, and allowance of the application in view of the remarks below.

I. Amendments to the Claims

Claims 1, 2, 4-8, and 10-20 are pending in the case of which claim 18 is amended. Specifically, claim 18 is amended to remove the word “about” and can be supported by Applicant’s specification at, for example, page 6, lines 7-8. Applicant believes these amendments introduce no new material.

Applicant reserves the right to file divisional or continuation applications directed to subject matter cancelled herein.

II. Rejection of Claims Under 35 U.S.C. § 112, First Paragraph

The Examiner maintains his rejection of claims 10 and 11 for reciting “a pH of between 1 and 5” and asserts that pH 5 was not originally disclosed. Applicant respectfully points out that a pH between 1 and 5 for the diluted pesticide is supported by Applicant’s specification at, for example, page 2, lines 12-13.

The Examiner again rejects claim 18 for reciting “about 3 to about 32 gallons per acre” and asserts there is insufficient descriptive support for the term about. Applicant in no way acquiesces to the rejection, but in the interest of expediting prosecution, claim 18 is amended.

III. Rejection of Claims Under 35 U.S.C. § 103(a)

The Examiner maintains his rejection of claims 1-2, 4-8, 10-11, and 16-20 as obvious over CN 1252940 in view of The Agrochemicals Handbook, Farm Chemicals Handbook ’98, Fritz et al. (U.S. 3,879,188), and CABA abstract 80:49077, further in view of the Ethephon publication and Imidacloprid publication. The Examiner also maintains his rejection of claims 1-2, 4-8, and 10-20 as obvious over Fritz et al. in view of CABA abstract 80:49077, The Agrochemicals Handbook, Farm Chemicals Handbook ’98, CN1252940, and the Ethephon publication.

Applicant respectfully requests withdrawal of both rejections. The Examiner asserts that it was known by one skilled in the art at the time the application was filed that addition of an acid to ethephon promotes stability and, as such, it would be obvious that the greater stability, i.e. less

degradation of ethephon would suggest greater efficiency and efficacy. Likewise, less stability would equal less ethephon suggesting less efficacy and less efficiency.

The Examiner bears the burden of establishing a *prima facie* case of obviousness. In determining obviousness, one must focus on the invention as a whole. *Symbol Technologies Inc. v. Opticon Inc.*, 19 USPQ 2d 1241, 1246 (Fed. Cir. 1991). The primary inquiry is: "[w]hether the prior art would have suggested to one of ordinary skill in the art that this process should be carried out and would have had a reasonable likelihood of success Both the suggestion and the expectation of success must be found in the prior art, not the applicants disclosure." *In re Dow Chemical*, 5 USPQ 2d 1529, 1531 (Fed. Cir. 1988).

Examination Guidelines for determining obviousness are set forth in Section 2141 of the MPEP, which provides in relevant part:

As reiterated by the Supreme Court in *KSR* [*KSR International Co. v. Teleflex, Inc.* 550 U.S. ___, 82 USPQ2d 1385 (2007)], the framework for the objective analysis for determining obviousness under 35 U.S.C. 103 is stated in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966). Obviousness is a question of law based on underlying factual inquiries. The factual inquiries enunciated by the Court are as follows:

- (A) Ascertaining the [scope and content of] the prior art; and
- (B) Ascertaining the differences between the claimed invention and the prior art; and
- (C) Resolving the level of ordinary skill in the pertinent art.

Objective evidence relevant to the issue of obviousness must be evaluated by Office personnel. *Id.* at 17-18, 148 USPQ at 467. Such evidence, sometimes referred to as "secondary considerations," may include evidence of commercial success, long-felt but unsolved needs, failure of others, and unexpected results. The evidence may be included in the specification as filed, accompany the application on filing, or be provided in a timely manner at some other point during the prosecution. . . .

The question of obviousness must be resolved on the basis of these factual determinations. While each case is different and must be decided on its own facts, the *Graham* factors, including secondary considerations when present, are the controlling inquiries in any obviousness analysis. The *Graham* factors were reaffirmed and relied upon by the Supreme Court in its consideration and determination of obviousness in the fact situation presented in *KSR*, 550 U.S. at ___, 82 USPQ2d at 1391 (2007). The Supreme Court has utilized the *Graham* factors in each of its obviousness decisions since *Graham*. . . . As stated by the Supreme Court in *KSR*, "While the sequence of these questions might be

reordered in any particular case, the [*Graham*] factors continue to define the inquiry that controls." *KSR*, 550 U.S. at ___, 82 USPQ2d at 1391.

(MPEP § 2141, page 2100-116 (Rev. 6, Sept. 2007) (citations omitted)). Subsequent to *Graham* other "secondary factors" have been considered by the courts as indicators of non-obviousness including copying, praise and industry acceptance. (See e.g., *Allen Archery, Inc. v. Browning Mfg. Co.*, 819 F.2d 1087, 1092, 2 USPQ2d 1490, 1493 (Fed. Cir. 1987); *Diversitech Corp. v. Century Steps, Inc.*, 850 F.2d 675, 679, 7 USPQ2d 1315, 1319 (Fed. Cir. 1988)).

Applicant sets forth below compelling evidence of non-obviousness related to the success of the present invention. Secondary considerations addressed include unexpected results, long-felt and unmet need, and copying.

More than 40 years ago, the conventional wisdom was that ethylene evolution from phosphonic compounds increased as pH increased, and stopped below pH 5. See Warner and Leopold, *Plant Physiol.* (1969) 44: 156-158, at page 156, column 2, lines 9-17; enclosed for the Examiner's convenience. It was therefore common practice to apply ethephon at a pH of approximately 5. Recognizing a need for increasing the efficacy of ethephon, in 1994, Atwater filed a patent application (now U.S. Patent No. 5,541,149) directed to a composition of an amide-sulfuric acid adduct and a phosphonic acid which purportedly increased defoliation and growth inhibition efficacy when applied to plants. Then years later, Applicant conceived of a simpler formulation, independent of the amide adduct, that surprisingly improved defoliation and growth inhibition efficiency and efficacy with much less corrosive acids. Applicant conceived of using phosphonic compounds in combination with specific acids including muratic, nitric, phosphoric, phosphorus, poly-phosphoric, perchloric, citric, and acetic acids, and performed his experiments with muratic acid. Applicant's application published in June of 2005. Fourteen months later, Volgas et al. filed a patent application (published as U.S. Patent Application Publication No. 2007/0037707, now abandoned, and assigned to Helena Holding Company) which essentially copied Applicant's invention. Volgas et al. point out that there remains a need for agricultural compositions in which the acid adjuvant is "built in" or co-formulated with the active ingredient:

Acidic adjuvants have commonly been used as pH modifiers or buffers for agricultural pesticide applications. . . .

These acids are used to modify the pH of spray solutions and are added separately to the spray solution by the applicator. Reduced pH can improve

uptake of herbicides. . . . Acids have also been used to prevent alkaline hydrolysis of some pesticides. . . .

One such acidic adjuvant that has been applied with positive effect with (2-chloroethyl) phosphonic acid is called LI-700. LI-700 contains predominantly propionic acid and surfactants. LI-700 has been sold as an adjuvant or additive, and can not be reliably co-formulated with (2-chloroethyl)phosphonic acid.

Another such adjuvant that has been applied with positive effect with (2-chloroethyl) phosphonic acid contains both citric and phosphoric acid. This adjuvant has only been sold as a tank mix additive for (2-chloroethyl) phosphonic acid.

See Volgas et al., paragraphs [0004] – [0007]. Volgas et al. also point out the advantages to formulating pesticides with the acid adjuvant built in, including the convenience to the user and consistency of the applied formulations. See Volgas et al., paragraph [0008].

Thus, in light of the evidence provided regarding unexpected results, long-felt and unmet need, and copying, the Examiner's finding of obviousness is certainly rebutted. Had the subject matter of Applicant's claims been obvious as the Examiner insists, Applicant's claimed improved formulations would most likely have been in use long ago. In fact, the opposite is true and as such, Applicant's claims are non-obvious over the publications cited by the Examiner.

Applicant would be happy to provide the above-information in the form of an Inventor's Declaration if it would be helpful to the Examiner.

For the reasons set forth above, Applicant respectfully submits the claims are allowable over the art of record and reconsideration and issuance of a notice of allowance are respectfully requested. If it would be helpful to obtain favorable consideration of this case, the Examiner is encouraged to call and discuss this case with the undersigned.

This constitutes a request for any needed extension of time and an authorization to charge all fees therefor to deposit account No. 19-5117, if not otherwise specifically requested. The undersigned hereby authorizes the charge of any fees created by the filing of this document or any deficiency of fees submitted herewith to deposit account No. 19-5117.

Appl. No. 10/728,419
Amdt. Dated: February 10, 2010
Reply to August 10, 2009 Office Action

Respectfully submitted,

Dated: February 10, 2010

/Cara L. Crowley-Weber/
Cara L. Crowley-Weber, #58,174
Swanson & Bratschun, L.L.C.
8210 SouthPark Terrace
Littleton, Colorado 80120
Telephone: 303.268.0066
Facsimile: 303.268.0065

S:\ClientFolders\0261 (Agquam)\AQM.01\OA Response 2010-02-10.doc

Short Communication

Ethylene Evolution From 2-Chloroethylphosphonic Acid¹

H. L. Warner and A. C. Leopold

Horticulture Department, Purdue University, Lafayette, Indiana 47907

Received June 10, 1968.

Strong growth regulating properties have been observed for 2-chloroethylphosphonic acid (Amchem 66-329) when applied to plants, and the regulatory effects have been attributed to the liberation of ethylene within plants (5). Many regulatory effects of this chemical resemble the effects of ethylene, including the induction of ripening in bananas and tomatoes (4), flowering in pineapple, and abscission and various epinastic responses (1). The present report provides evidence that 2-chloroethylphosphonic acid (CEPA) breaks down in the presence of a base to form ethylene with an apparent release of chloride and phosphonate.

To illustrate the decomposition reaction, 5 ml of CEPA at 2×10^{-4} M in a 1000 ml reaction flask, with either NaOH (8×10^{-4} M) or 500 mg of etiolated pea epicotyls, evolve ethylene as shown in figure 1. The production of ethylene occurs not only in the presence of the plant tissue, but also in the presence of added base. In this experiment 1.0 μ mole of CEPA was present initially and 0.98 μ mole of ethylene had been produced 48 hr after addition of NaOH, indicating essentially complete conversion of the CEPA to ethylene. The logarithmic type of time curve in the presence of added base suggests a second-order reaction, possibly involving the alkali in reaction with CEPA. The rate of the reaction is increased by higher levels of added alkali.

That the gas involved is ethylene was determined by gas chromatography (2) and its identity was confirmed by reaction with mercury perchlorate (6). The gas chromatographic peak considered to be ethylene was 99.2 % removed by introduction into the reaction flask of a paper wick moistened with $\text{Hg}(\text{ClO}_4)_2$.

The decomposition of CEPA to ethylene should bring about the release of phosphonate and chloride. As an indication of phosphonate formation, in a test run concurrently with the experiment in figure 1 phosphate was measured by Allen's molybdate color test, assuming a fairly ready oxidation of the phos-

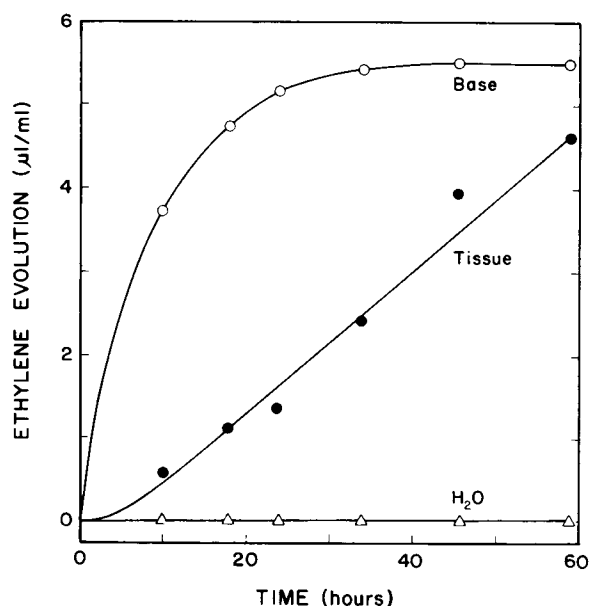


FIG. 1. Ethylene evolution from CEPA in the presence of NaOH or pea epicotyls. CEPA at 2×10^{-4} M in 5 ml of H_2O , with NaOH (8×10^{-4} M) or 0.5 g pea epicotyls. Ethylene evolution expressed as μ l per ml of solution, measured by gas chromatography of 1 ml sample of the ambient air at the times indicated.

phonate ion to phosphate. The results in figure 2 show a time course similar to that of ethylene evolution, though only 36 % yield of phosphate was obtained. Presumably the lesser yield was due to incomplete oxidation of phosphonate to phosphate. The presence of chloride ion was detectable at the end of the 48 hr reaction time, using silver nitrate as an indicator.

The effects of pH were examined in buffered 2.5 ml solutions of 1000 ppm CEPA (17.5 μ moles) maintained by 0.1 M citrate-NaOH between pH 4 and 6 or by 0.1 M tris malate-NaOH buffer between pH 6 and 8. The data presented in figure 3 indicate no optimum pH for ethylene evolution, but rather an increasing evolution with increasing pH. The minimum pH at which ethylene evolution was detected was pH 5. In buffered solutions, ethylene

¹ Journal paper No. 3471, Agricultural Experiment Station, Purdue University, Lafayette, Indiana.

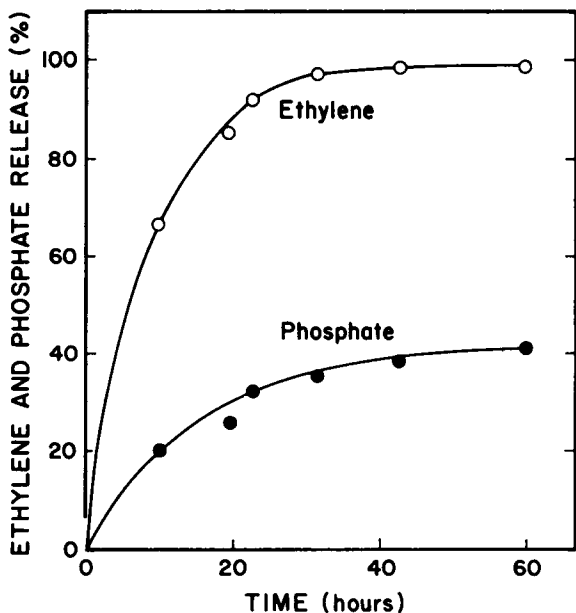


FIG. 2. Ethylene evolution and phosphate release from CEPA. Reactions were carried out as in figure 1, CEPA (2×10^{-4} M) plus NaOH (8×10^{-4} M), 5 ml volume. Ordinate as % of theoretical.

evolution proceeds linearly with time for the first 7 hr. The time curve for the formation of ethylene from CEPA in pea stem tissue was (fig 1).

Plant tissues of different acidity might be expected to show different capacities for ethylene evolution. To test this hypothesis plants of *Bryophyllum cruentum* Baker were placed under short-day and long-day conditions to obtain different degrees of tissue acidity. After 10 days of controlled photo-periods, leaves from plants in each condition were

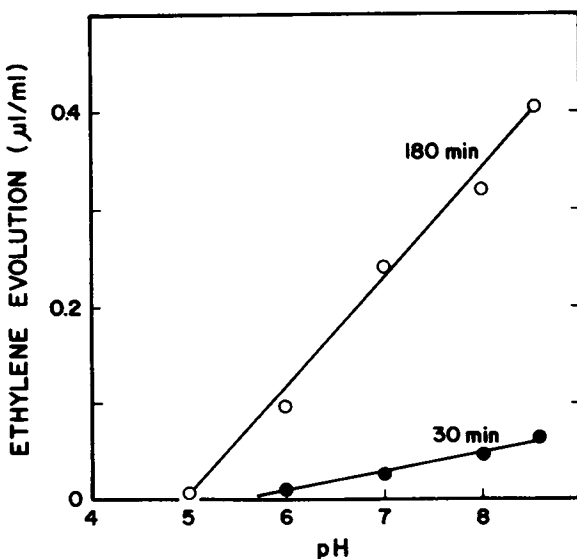


FIG. 3. The effect of pH on ethylene evolution from CEPA. 2.5 ml of 1000 ppm CEPA (17.5 μ moles) were reacted in 20 ml reaction flasks buffered at pH 4 to 8.

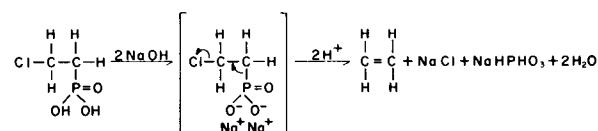
allowed to take up by transpiration 1000 ppm CEPA in H_2O for 2 hr. The leaves were then washed and placed in 250 ml flasks for measurement of ethylene evolution. Table I indicates that the leaves from the long-day conditions produced substantially more ethylene after removal from CEPA solutions than leaves from the short-day condition, as would be expected from their relatively greater pH (pH 4.6 and 4.0 respectively).

Table 1. Rate of Ethylene Evolution from Leaves of *Bryophyllum*

Plants were pretreated with 10 short days or long days then leaves excised and allowed to take up 1000 ppm (17.5 μ moles) CEPA or water for 2 hr before start of measurements of ethylene formation.

Time hr	Ethylene evolution μ l g^{-1} hr^{-1}			
	Long day CEPA	H_2O	Short day CEPA	H_2O
1	367	0.2	138	0.2
6	362	0.3	102	0.4
22	157	...	35	...
48	63	...	21	...

The breakdown of CEPA into ethylene in the presence of a base appears to be a second-order reaction and apparently leads to the production of phosphonate and chloride. We suggest that the reaction involves the removal of the phosphonate as a salt followed by dehydrohalogenation. The hydroxyl groups of the phosphonate would be dissociated in the presence of base to form a strong negative charge, the carbon-phosphonate bond would break with the donation of an electron to the double bond of the alkene, and the chloride would be eliminated as shown below.



It is likely that CEPA is taken up in plants as is any weak aliphatic acid and subsequently breaks down at cytoplasmic pH with the formation of ethylene which then may cause the regulation of various aspects of plant growth.

After the completion of this manuscript, a similar suggestion for the breakdown of CEPA was made by Cooke and Randall (3), though without presenting data or evidence for the nature of the gas produced. They suggest that the ethylene release may be responsible for the biological activities of CEPA, a suggestion which had been documented previously (5). They point out that enzymes in the plant may participate in the reactions leading to ethylene formation, especially where esters are present in the applied material.

Literature Cited

1. AMCHEM PRODUCTS INC. 1967. Amchem 66-329, a new plant growth regulator. Information Sheet 37.
2. BURG, S. P. AND K. V. THIMANN. 1959. The Physiology of Ethylene Formation in Apples. Proc. Natl. Acad. Sci. 45: 335-44.
3. COOKE, A. R. AND D. I. RANDALL. 1968. 2-Haloethanephosphonic acids as ethylene releasing agents for the induction of flowering in pineapples. Nature 218: 96-97.
4. RUSSO, L., H. C. DOSTAL, AND A. C. LEOPOLD. 1968. Chemical stimulation of fruit ripening. Bioscience 18: 109.
5. WARNER, H. L. AND A. C. LEOPOLD. 1967. Plant growth regulation by stimulation of ethylene production. Bioscience 17: 722.
6. YOUNG, R. E., H. K. PRATT, AND J. B. BIALE. 1951. Identification of ethylene as a volatile product of the fungus *Penicillium digitatum*. Plant Physiol. 26: 304-09.